EXPLANATION OF DISPARITY BETWEEN METHODS OF CALCULATING DE MINIMIS, PLUS ADDITIONAL COMMENTS
September 9, 2008, Jeff Hyman, Conservation Law Center

At the end of the antidegradation working session on August 12, 2008, Albert Ettinger proposed to the group an example of how the proposed OSRW *de minimis* of "meeting the water quality standard at the end of the pipe (without dilution)" can be less stringent than the proposed non-OSRW HQW *de minimis* of "10% of the unused loading capacity." The following explains that example.

EXAMPLE

Albert's example goes as follows:

Let's say we have a stream with a flow rate of 2 (units: cubic feet per second [cfs] or liters per second [L/s]). The permit applicant takes 1 L/s from the stream, pollutes it up to the water quality standard and puts in back into the stream with pollution. The water quality standard for the pollutant, X, is 10 mg/L with the water totally free of X above the plant. The discharger discharges at 10 mg/L (the WQS at the end of the pipe) and this water would then merge with the 1 L/s that was not taken into the plant. The resulting water quality below the plant would be as follows: the 2 L/s stream would contain 5 mg/L of X. Thus, 50% of the assimilative capacity has been used by the discharger.

Now, if the stream were an OSRW, the proposed pollution would pass as de minimis because the discharge meets the water quality standard for pollutant X at the end of the pipe. However, unless another exemption applied, this discharge would have to go through antidegradation demonstration for non-OSRWs because 50% of the assimilative capacity is greater than 10% of the assimilative capacity, the purported *de minimis* for non-OSRWs. Obviously, the situation could be worse if the dilution were less than 1:1, but the logical problem that OSRWs are getting less protection than other HQWs would remain as long as the dilution was less than 10:1.

EXPLANATION OF EXAMPLE OUTCOMES

There appeared to be confusion in the group about how such an outcome is possible. The following calculations show how, and why, the above outcome occurs.

Assuming as Albert does that the stream water does not contain any of the pollutant X prior to the proposed discharge, the unused loading capacity (ULC) is given by the following equation:

$$ULC = (Cr)(Qe + Qw) \qquad \text{[Eqn. 1]}$$

where Cr is the criterion value or water quality standard, Qe is the effluent flow, and Qw is the stream $Q_{7,10}$ flow (the stream design flow).

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STEP 1

In Albert's example, the facility discharges the WQBEL at the end of the pipe, which is essentially the criterion concentration of 10 mg/L. Thus, *Cr* = 10 mg/L, and the flows are *Qe* = 1 L/s and *Qw* = 1 L/s.

With these numbers plugged into Eqn. 1, the ULC equals 20 mg per second.

$$ULC = (Cr)(Qe + Qw) = (10\ mg/L)(1\ L/s + 1\ L/s) = 20\ mg/s \qquad \text{[Eqn. 2]}$$

That is, the loading of pollutant X at 20 mg/s would produce an instream concentration of 10 mg/L (*i.e.*, the criterion value). This loading reflects the capacity of the stream to assimilate pollutant X before overshooting the criterion concentration.

STEP 2

Now, IDEM currently proposes that the *de minimis* level for a new discharge into an OSRW be the WQBEL at the end of the pipe, that is, without dilution (no mixing zone) (if more stringent than the DTBEL – see August 4th draft rule §4(b)(13)(B)). The WQBEL at the end of the pipe is given as follows:

$$WQBEL\ no\ dilution = (Cr)(Qe + (0)Qw) = (10\ mg/L)(1\ L/s + 0\ L/s) = 10\ mg/s \qquad \text{[Eqn. 3]}$$

Thus, if the discharger puts 10 mg/s or less of pollutant X into the stream, the discharge meets the *de minimis* for an OSRW.

As a result, the concentration of X in the 2 L/s of flow in the stream is thus 5 mg/L:

$$Concentration\ of\ X\ in\ Stream = Loading\ /\ Flow = (10\ mg/s)\ /\ (2\ L/s) = 5\ mg/L \qquad \text{[Eqn. 4]}$$

Thus, discharging 10 mg/s of pollutant X into 2 L/s flow (1 L/s of effluent flow plus 1 L/s flowing from upstream) produces a concentration of 5 mg/L of X in the stream.

But this resulting concentration is <u>50% of the unused loading capacity</u>: 5 mg/L is 50% of the criterion value of 10mg/L, and the end-of-pipe WQBEL of 10 mg/s is 50% of the ULC of 20 mg/s.

In this example, loading pollutant X into the stream at the level of the end-of-pipe WQBEL, which is IDEM's proposed OSRW *de minimis* level, has used up much more than 10% of the ULC, which is IDEM's <u>purported</u> (as opposed to actual) proposed *de minimis* for non-OSRWs. In other words, the new loading meets the *de minimis* for OSRWs but does not meet the purported *de* *minimis* for non-OSRWs. This result is contrary to the principle that OSRWs should receive more protection than non-OSRWs.

STEP 3

How can a discharge at the proposed OSRW *de minimis* level be "significant" when compared to IDEM's proposed *de minimis* for non-OSRWs?

THE ANSWER IS: BECAUSE IDEM'S PROPOSED METHODS FOR CALCULATING *DE MINIMIS* ARE NOT APPROPRIATELY LINKED TO THE CONCEPT OF 10% UNUSED LOADING CAPACITY.

IN PARTICULAR, IN CONTRAST TO IDEM'S PAST STATEMENTS, 10% OF THE UNUSED LOADING CAPACITY IS NOT EQUAL TO, AND IS NOT ACCURATELY APPROXIMATED BY, IDEM'S PROPOSED NON-OSRW *DE MINIMIS* OF "WQBEL USING 10% OF THE DESIGN FLOW."

STEP 4

To be sure, IDEM is correct to say that the end-of-pipe WQBEL without dilution will typically be more stringent than the WQBEL using 10% of the design flow. This intuitive result is illustrated by plugging in the above numbers in the following two equations:

$WQBEL\ no\ dilution = (Cr)(Qe + (0)Qw) = (10\ mg/L)(1\ L/s + 0\ L/s) = 10\ mg/s$ [Eqn. 5]

$WQBEL\ w\ 10\%\ Q_{7,10} = (Cr)(Qe + (10\%)(Qw)) = (10mg/L)\ (1\ L/s + 0.1(1\ L/s)) = 11\ mg/s$ [Eqn. 6]

The WQBEL without dilution produces 5 mg/L concentration in the 2 L/s flow volume, whereas the WQBEL using 10% of the design flow produces 5.5 mg/L concentration in the 2 L/s flow volume.

STEP 5

But, and this is the critical point, the WQBEL using 10% of the design flow is not mathematically equivalent to 10% of the ULC. Remember that 10% of the ULC (or 10% of the assimilative capacity) is the standard that EPA and the courts say is the maximum acceptable *de minimis* level. If IDEM intends the WQBEL using 10% of the design flow to approximate the value of 10% of the ULC, that simply will not work in cases where the effluent flow *Qe* is large relative to the design flow *Qw* of the stream.

To see this, compare 10% of the ULC with the WQBEL using 10% of the design flow, plugging in the above numbers:

$WQBEL\ w\ 10\%\ Q_{7,10} = (Cr)(Qe + (10\%)(Qw)) = (10 mg/L)\ (1\ L/s + 0.1(1\ L/s)) = 11\ mg/s$ [Eqn. 7]

$10\%\ of\ ULC = (0.1)\ [(Cr)(Qe + Qw)] = (0.1)\ [(10 mg/L)\ (1\ L/s + 1\ L/s)] = 2\ mg/s$ [Eqn. 8]

That is, the discharge would have to be no more than 2mg/s of pollutant X to use no more than 10% of the ULC. And the discharge of 2 mg/s of X into 2 L/s of flow gives an instream concentration of 1 mg/L, which is exactly equal to 10% of the criterion value of 10 mg/L.

The only situation where the "WQBEL using 10% of the design flow" is a reasonable estimator of "10% of the "unused loading capacity" is where the effluent flow *Qe* is very small relative to the stream design flow *Qw*. For example, consider the situation where *Qe* is one-tenth of *Qw*.

Say $Qe = 1$ and $Qw = 10$. Then:

$WQBEL\ w\ 10\%\ Q_{7,10} = (Cr)(Qe + (10\%)(Qw)) = (10 mg/L)\ (1\ L/s + 0.1(10\ L/s)) =20\ mg/s$ [Eqn. 9]

$10\%\ of\ ULC = (10\%)\ [(Cr)(Qe + Qw)] = (0.1)\ [(10 mg/L)\ (1\ L/s + 10\ L/s)] = 11\ mg/s$ [Eqn. 10]

Even with a *Qw:Qe* ratio of 10:1, the WQBEL using 10% of the design flow is still much higher than, and a poor approximation to, 10% of the ULC. As the equation shows, however, in general as the *Qw:Qe* ratio increases, the ratio of $WQBEL\ w\ 10\%\ Q_{7,10}$ to *10% of ULC* decreases.

The main error in using the WQBEL approximation for the *de minimis* is that a new discharge will in many flow situations be exempted as *de minimis* even though the discharge uses more than 10% of the unused loading capacity (assimilative capacity).

Note also that at the *Qw:Qe* ratio of 10:1, IDEM's proposed OSRW *de minimis* of "WQBEL with no dilution" will be slightly more stringent than IDEM's <u>intended</u> non-OSRW *de minimis* of "10% of the ULC." To see this, compare the following equation with Eqn. 10:

$WQBEL\ no\ dilution = (Cr)(Qe + (0)Qw) = (10\ mg/L)(1\ L/s + 0\ L/s) = 10\ mg/s$ [Eqn. 11]

SUMMARY OF POINTS

- IDEM's use of the "WQBEL using 10% of the design flow" as an approximation to IDEM's intended non-OSRW *de minimis* of "10% of the unused loading capacity" cannot be supported except in situations where the flow volume of the waterbody is much larger than the effluent flow.

- For low-flow OSRW streams, the proposed *de minimis* of the "WQBEL without dilution" will be LESS STRINGENT than the proposed non-OSRW *de minimis* of "10% of the unused loading capacity" correctly calculated or estimated.

ADDITIONAL COMMENTS REGARDING *DE MINIMIS*

- The *de minimis* level for OSRWs, such as Lake Michigan, should be significantly more stringent than the intended non-OSRW *de minimis* of "10% of the unused loading capacity."
- Background concentration is a valid and logical *de minimis* for OSRWs, even given the OSRW legislation in Ind. Code §13-18-3-2, because (1) the current concentration in a discharge may be below the background level for at least some dischargers and pollutants; and (2) Ind. Code §13-18-3-2(m) says that the rules must provide for "a de minimis quantity of additional pollutant load," and an increased loading does not necessarily mean an increase in concentration in the waterbody.
- IDEM's proposal to use the FAV (final acute value) as the WLA ceiling is arbitrary and is the least protective value IDEM could have chosen and still be within the requirements of the law. Even the acute aquatic criterion (AAC), which is one-half the FAV, would be a better policy choice than the FAV.